WHAT IS CLAIMED IS:

1. In a device for configuring a downlink signal in a mobile communication system, a device for configuring a downlink signal, comprising:

a first preamble generator for generating a first preamble having a first symbol and a second symbol so that a phase difference between the first and second symbols may be 180° for the purpose of time and frequency synchronization;

a second preamble generator for generating a second preamble including at least one transmit symbol so that the second preamble may have specific patterns for a plurality of cells for the purpose of cell search; and

a pilot pattern generator for generating a pilot pattern to be allocated to a plurality of pilot symbols to be provided on the time axis and the frequency axis, wherein

a frame of the downlink signal includes a first slot which has the first and second preambles, and a plurality of second slots having the pilot symbols.

2. The device of claim 1, wherein the first symbol is a symbol which is repeated at intervals of a predetermined time period, and the second symbol is part of the first symbol with the phase rotated by 180°.

3. The device of claim 2, wherein the first symbol has a valid symbol length which corresponds to a difference between a length of the

transmit symbol and a length of a cyclic prefix, and

the second symbol corresponds to the length of the cyclic prefix starting from the beginning part of the first symbol with the phase rotated by 180°.

4. The device of claim 1, wherein the second preamble generator allocates a second preamble specific to each cell when the number of cells of the mobile communication system is less than the number of second preambles, and it divides the cells into groups by the number of the second preambles and allocates a second preamble specific to each cell when the number of cells is greater than the number of second preambles, in a second preamble set which includes a plurality of second preambles classified by a transmitted time, a transmitted subcarrier, and a signal pattern.

5. The device of claim 4, wherein the second preamble generator generates the second preamble so that one second preamble may not transmit signals in a subcarrier on which another second preamble transmits signals, in at least one of the symbols through which the second preamble transmits the signals from among the two different second preambles.

6. The device of claim 4, wherein in the second preamble generator, another cell search preamble transmits no signals on the subcarrier through which a second preamble transmits signals, in at least one of the symbols through which the second preamble transmits signals

in the two second preambles belonging to different groups, and

the two second preambles belonging to the same group use the same subcarrier in the same transmit symbol, and allocate a signal pattern distinguishable by using a predefined receive signal processing method.

7. The device of claim 1, wherein the pilot symbol is transmitted at a predefined transmit symbol position and on a subcarrier predefined by the corresponding transmit symbol, and

the pilot pattern generator forms a set of pilot patterns which are distinguishable by a signal pattern transmitted to the subcarrier of the transmit symbol for transmitting the pilot symbol, and the pilot pattern generator allocates a pilot pattern specific to each cell when the number of the cells of the mobile communication system is less than the number of the pilot patterns, and divides the cells into groups by the number of the pilot patterns and allocates different pilot patterns in a group when the number of the cells is greater than the number of the pilot patterns.

8. The device of claim 7, wherein the pilot pattern includes a first pattern which is common to the pilot patterns in the set of pilot patterns, and a second pattern distinguishable by the pilot patterns within the set of pilot patterns.

9. The device of claim 1, wherein the pilot slot is provided on the time axis and the frequency axis for each transmit antenna.

10. The device of claim 9, wherein the subcarriers for transmitting

pilot symbols of different transmit antennas are formed at different positions, and the pilot pattern over the subcarriers within a transmit symbol is the same for a plurality of transmit antennas.

11. The device of claim 10, wherein a subcarrier group for transmitting the pilot symbols by the number of the maximum transmit antennas in common for two adjacent cells is formed, and the pilot symbols which correspond to the respective transmit antennas are differently mapped in the subcarrier group of the two cells.

12. The device of claim 11, wherein the mapping of the pilot symbols is varied for each predetermined period.

13. A downlink signal synchronizer in a mobile communication system wherein a frame of the downlink signal comprises: a first slot which includes a first preamble for time and frequency synchronization and a second preamble which has a pattern specific to each cell for cell search; and a plurality of second slots which have a plurality of pilot symbols provided on the time axis and the frequency axis, the downlink signal synchronizer comprising:

an initial synchronization estimator which includes an initial symbol synchronization estimator for using a cyclic prefix of the downlink signal and estimating initial symbol synchronization; a frame synchronization estimator for using the symbol synchronization estimated by the initial symbol synchronization estimator and the first preamble and estimating frame synchronization; and a time and frequency

synchronization estimator for using the estimated frame synchronization and the first and second preambles and estimating fine symbol synchronization and frequency synchronization; and

a cell searcher for using a pattern specific to each cell of the second preamble and searching the cells when the symbol synchronization and the frequency synchronization are controlled by the initial synchronization estimator.

14. The downlink signal synchronizer of claim 13, wherein the initial symbol synchronization estimator estimates a position for maximizing the autocorrelation of the cyclic prefix of the transmit symbol and a valid symbol during a transmit symbol period, by using a symbol timing.

15. The downlink signal synchronizer of claim 13, wherein the first preamble includes a first symbol which has a valid symbol length, and a second symbol which corresponds to part of the first symbol with a phase rotated by 180°.

16. The downlink signal synchronizer of claim 15, wherein the frame synchronization estimator comprises:

a delay unit for delaying the received signal by a length of the valid symbol length;

a moving average unit for calculating a moving average of a correlation value of the signal delayed by the delay unit and the received signal; and

a sign detector and comparator for detecting a sign of the real number part of the moving average, and determining a predetermined timing to be a frame timing, wherein the predetermined timing has the sign of the real number part as -1 and the absolute value of the real number part as the maximum value.

17. The downlink signal synchronizer of claim 13, wherein the time and frequency synchronization estimator comprises:

a preamble storage unit for storing a pattern of the first preamble;

a correlator for calculating a correlation value of the downlink signal and the first preamble pattern; and

a comparator for estimating a point for the maximum correlation value, and estimating fine symbol synchronization.

18. The downlink signal synchronizer of claim 13, wherein a pilot pattern of the pilot symbol in the second slot includes a first pattern in common for each cell, and a second pattern different for each cell,

the initial synchronization estimator further comprises a slot synchronization estimator for using a symbol synchronization estimated by the initial symbol synchronization estimator and the first pattern and estimating slot synchronization, and

the frame synchronization estimator uses the slot synchronization estimated by the slot synchronization estimator and the first preamble, and estimates frame synchronization.

19. The downlink signal synchronizer of claim 18, wherein the slot

synchronization estimator comprises:

a cell common pilot selector for using the estimated symbol synchronization, Fourier-transforming the downlink signal, and selecting a cell common pilot signal;

a correlator of the common pilot signal and the first pattern; and

a comparator for selecting a point for maximizing the correlation value as a slot timing, and estimating the slot synchronization.

20. The downlink signal synchronizer of claim 18, wherein the pilot slots in the second slot are provided on the time axis and the frequency axis for each transmit antenna, and

the downlink signal synchronizer further comprises: an antenna power comparator for using the estimated initial symbol synchronization to estimate a signal power for each transmit antenna and compare the signal power with a predefined reference value; and an antenna signal select combiner for selecting or combining a first pattern of the transmit antenna which has a power greater than the reference value and allowing the slot synchronization estimator to estimate the slot synchronization.

21. The downlink signal synchronizer of claim 18, wherein the initial symbol synchronization estimator excludes a result which corresponds to a symbol start position of the current cell from the autocorrelation result of the cyclic prefix of the transmit symbol and the valid symbol, estimates a point for maximizing the autocorrelation result, and estimates symbol synchronization of adjacent cells,

the slot synchronization estimator uses the estimated symbol synchronization of the adjacent cells and the first pattern to estimate correlation, and excludes a point which corresponds to the current cell from the correlation result to estimate slot synchronization of the adjacent cells,

the frame synchronization estimator excludes a result which corresponds to a frame start position of the current cell from the autocorrelation result of the estimated slot synchronization of the adjacent cells and the first preamble, estimates a point for maximizing the autocorrelation result, and estimates frame synchronization of the adjacent cells, and

the time and frequency synchronization estimator excludes a result which corresponds to a symbol start position of the current cell from the correlation result of the downlink signal and the first preamble pattern, estimates a point for maximizing the correlation result, and estimates fine symbol synchronization of the adjacent cells.

22. The downlink signal synchronizer of claim 21, wherein the cell searcher excludes a result which corresponds to the current cell from the cell search result, and searches the adjacent cells.

23. The downlink signal synchronizer of claim 13, wherein the initial symbol synchronization estimator excludes a result which corresponds to a symbol start position of the current cell from the autocorrelation result of the cyclic prefix of the transmit symbol and the

valid symbol, estimates a point for maximizing the autocorrelation result, and estimates symbol synchronization of adjacent cells,

the frame synchronization estimator excludes a result which corresponds to a frame start position of the current cell from the autocorrelation result of the estimated symbol synchronization of the adjacent cells and the first preamble, estimates a point for maximizing the autocorrelation result, and estimates frame synchronization of the adjacent cells, and

the time and frequency synchronization estimator excludes a result which corresponds to a symbol start position of the current cell from the correlation result of the downlink signal and the first preamble pattern, estimates a point for maximizing the correlation result, and estimates fine symbol synchronization of the adjacent cells.

24. The downlink signal synchronizer of claim 23, wherein the cell searcher excludes a result which corresponds to the current cell from the cell search result, and searches the adjacent cells.

25. In a method for synchronizing downlink signals of a mobile communication system, and searching cells wherein a frame of the downlink signal comprises: a first slot which includes a first preamble having a first symbol with a valid symbol length and a second symbol corresponding to part of the first symbol with a phase rotated by 180°, and a second preamble which has a pattern specific to each cell for cell search; and a plurality of second slots which have a plurality of pilot

symbols provided on the time axis and the frequency axis, a method for synchronizing downlink signals and searching cells, comprising:

(a) estimating a point at which correlation of a cyclic prefix of the downlink signal and a valid symbol becomes the maximum as a symbol timing, and estimating initial symbol synchronization;

(b) using a characteristic that the real number part of the autocorrelation of the estimated initial symbol synchronization and the first and second symbols has a negative sign, and estimating frame synchronization;

(c) using the estimated frame synchronization and the first and second preambles, and estimating time and frequency synchronization; and

(d) using the second preamble and searching the cells when the time and frequency are synchronized through the synchronization step of (c).

26. The method of claim 25, wherein the step of (c) comprises:

detecting a phase of a moving average of a signal obtained by delaying the downlink signal by a repeated time difference and the downlink signal, and estimating a frequency offset;

estimating a point for maximizing the correlation result of the pattern of the first preamble and the downlink signal, and estimating fine symbol synchronization; and

using the second preamble, and estimating fine frequency

synchronization.

27. The method of claim 25, wherein a pilot pattern of the pilot symbol in the second slot includes a first pattern in common for each cell, and a second pattern different for each cell, and

the step of (b) comprises:

using the estimated symbol synchronization and the first pattern, and estimating slot synchronization; and

using a characteristic that the real number part of the autocorrelation of the estimated slot synchronization and the first and second symbols has a negative sign, and estimating frame synchronization.

28. The method of claim 27, wherein the pilot slots in the second slot are provided on the time axis and the frequency axis for each transmit antenna, and

the step of estimating the slot synchronization comprises:

using the estimated initial symbol synchronization, and estimating a signal power for each transmit antenna;

comparing the estimated signal powers of the respective antennas with a predefined reference value; and

selecting or combining the first pattern of the transmit antenna having a power greater than the reference value, and estimating slot synchronization.

29. In a method for synchronizing and searching adjacent cells

from downlink signals of a mobile communication system wherein a frame of the downlink signal comprises: a first slot which includes a first preamble having a first symbol with a valid symbol length and a second symbol corresponding to part of the first symbol with a phase rotated by 180°, and a second preamble which has a pattern specific to each cell for cell search; and a plurality of second slots which have a plurality of pilot symbols provided on the time axis and the frequency axis, a method for synchronizing adjacent cells and searching cells, comprising:

(a) calculating autocorrelation of a cyclic prefix of the downlink signal and a valid symbol;

(b) excluding a result which corresponds to a symbol start position of the current cell from a result of the autocorrelation, estimating a point for maximizing the autocorrelation, and estimating initial symbol synchronization of adjacent cells;

(c) using the estimated initial symbol synchronization of the adjacent cell, and estimating autocorrelation of the first preamble;

(d) excluding a result which corresponds to a frame start position of the current cell from a result of the autocorrelation estimated in (c), estimating a point for maximizing the result of the autocorrelation, and estimating frame synchronization of adjacent cells;

(e) using the estimated frame synchronization of the adjacent cells and the first and second preambles, and estimating time and frequency synchronization of the adjacent cells; and

(f) using the second preamble to search the cells, and excluding a result which corresponds to the current cell from the cell search result to search the cells.

30. The method of claim 29, wherein the step of (e) comprises:

using the first preamble, and estimating a frequency offset;

using the first preamble, and estimating symbol synchronization correlation;

excluding a result which corresponds to a symbol start position of the current cell from the symbol synchronization correlation result, estimating a point for maximizing the correlation result, and estimating fine symbol synchronization of the adjacent cell; and

using the second preamble, and estimating fine frequency synchronization.

31. The method of claim 29, wherein the step of (f) comprises: further using a specific pattern for each cell of the pilot symbol, and searching the cells.

32. In a method for synchronizing and searching adjacent cells from downlink signals of a mobile communication system wherein a frame of the downlink signal comprises: a first slot which includes a first preamble having a first symbol with a valid symbol length and a second symbol corresponding to part of the first symbol with a phase rotated by 180°, and a second preamble which has a pattern specific to each cell for cell search; and a plurality of second slots which have a plurality of pilot

symbols provided on the time axis and the frequency axis, and a pilot pattern of the pilot symbol in the second slot includes a first pattern in common for each cell and a second pattern different for each cell, a method for synchronizing adjacent cells and searching cells, comprising:

(a) calculating autocorrelation of a cyclic prefix of the downlink signal and a valid symbol;

(b) excluding a result which corresponds to a symbol start position of the current cell from a result of the autocorrelation, estimating a point for maximizing the autocorrelation, and estimating initial symbol synchronization of adjacent cells;

(c) using the estimated symbol synchronization of the adjacent cell, and signal-processing the first pattern;

(d) excluding a slot position of the current cell from the signal processed result in (c), selecting a point for maximizing the signal processed result, and estimating slot synchronization of adjacent cells;

(e) using the estimated slot synchronization of the adjacent cells, and estimating autocorrelation of the first preamble;

(f) excluding a result which corresponds to a frame start position of the current cell from a result of the autocorrelation estimated in (e), estimating a point for maximizing the result of the autocorrelation, and estimating frame synchronization of the adjacent cell;

(g) using the estimated frame synchronization of the adjacent cell and the first and second preambles, and estimating time and frequency

synchronization of the adjacent cell; and

(h) using the second preamble to search the cells, excluding a result which corresponds to the current cell from the cell search result, and searching the cells.

33. The method of claim 32, wherein the step of (g) comprises:

using the first preamble, and estimating a frequency offset;

using the first preamble, and estimating symbol synchronization correlation;

excluding a result which corresponds to a symbol start position of the current cell from the symbol synchronization correlation result, estimating a point for maximizing the correlation result, and estimating fine symbol synchronization of the adjacent cell; and

using the second preamble, and estimating fine frequency synchronization.

34. The method of claim 32, wherein the step of (h) comprises: further using a specific pattern for each cell of the pilot symbol, and searching the cells.

35. In a method for configuring downlink signals in a mobile communication system, a method for configuring downlink signals, comprising:

(a) generating a first preamble which includes a first symbol and a second symbol with the phase difference of 180° with respect to the first symbol;

(b) generating a second preamble having a specific pattern for each cell of a plurality of cells;

(c) generating the first and second preambles as a first slot; and

(d) arranging a plurality of pilot symbols on the time axis and the frequency axis, and generating a second slot.

36. The method of claim 35, wherein the step of (b) comprises generating the second preamble so that another second preamble transmits no signals on a subcarrier on which one second preamble transmits signals, in at least one of symbols by which the second preamble transmits signals in the two different preambles.

37. The method of claim 35, wherein the step of (b) comprises: preventing the another second preamble from transmitting signals on the subcarrier on which a second preamble transmits signals in at least symbol from among the symbols by which the second preamble transmits signals, in the two preambles belonging to different groups in a grouped cell search preamble set, and

using the same subcarrier in the same transmit symbol in the two second preambles belonging to the same group, using a predefined receive signal processing method, and allocating a distinguishable signal pattern.

38. The method of claim 35, wherein the step of (d) comprises: forming a set of pilot patterns distinguishable according to signal patterns transmitted to the subcarrier of the transmit symbol for transmitting the

pilot symbol, and allocating a pilot pattern specific to each cell.